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ABSTRACT

This report clarifies pilot efforts which address new problem areas in educational needs. The project was initiated to determine the specific competencies essential to the management of educational projects in research and development. The goals of the project were to establish a profile of identified competencies for use in planning the content of the intern training programs for women and minorities, and to prepare a profile for possible national dissemination. Among competency differences between program managers and program staff are: freedom to act in decision making; ability to handle diverse tasks in project management; and possession of technical expertise applicable to research and development. Effective management of research projects require competence in: (1) supervision; (2) budget management; (3) public relations; (4) communications; (5) documentation; (6) planning; and (7) evaluation. (JN)

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Competencies of Leaders and Managers in Educational Research and Development

By
Natividad DeAnda

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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INDEPENDENT RESEARCH AND DEVELOPMENT PROJECT REPORTS
REPORT NO. 4

SP 017 312

FAR WEST LABORATORY FOR EDUCATIONAL RESEARCH AND DEVELOPMENT

COMPETENCIES OF LEADERS AND MANAGERS IN EDUCATIONAL RESEARCH & DEVELOPMENT

Natividad DeAnda, Principal Investigator

Report # 4
Independent Research and Development Project Reports

June 30, 1980

FAR WEST LABORATORY FOR EDUCATIONAL RESEARCH AND DEVELOPMENT

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This project was supported by Laboratory funds. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the Laboratory.

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FOREWORD

This report describes the results of one in a series of Independent Research and Development Projects funded by the Far West Laboratory for Educational Research and Development, using its own resources generated by fees earned on various contracts. These Independent Research and Development Projects, conducted by individual professional staff members of the Laboratory, represent pilot efforts that address new problem areas of significance to regional or national educational needs or that probe new resource or methodological areas heretofore unexplored by Laboratory staff.

Awards are made on a competitive basis annually or semiannually, depending on available funds. In addition to requirements that the projects be completed within nine months and require less than one quarter person year effort of any Laboratory employee, the proposals are scored on four criteria: (a) they must promise to open a new area of research or development or extend significantly the productivity of an existing area, (b) they must be of high quality, (c) they must be difficult to fund through known private, governmental, or foundation funding, and (d) they must be closely related to the Laboratory's mission.

Following review by the Independent Research and Development Committee, recommendations for funding are forwarded through the Laboratory Director to the Program Committee of the Board of Directors of the Laboratory for their review and approval.

The following is a listing of the Independent Research and Development Project award recipients and a brief description of their projects.

Joaquin Armendariz. Development of Resources Relating to Systemic Design Models and Methodologies. This project tests the feasibility of developing instructional resources in design models and design methodologies for educational practitioners. Two monographs describing significant design approaches and key reference works will be prepared.

Ann Bouie. Identification of the Problematic Situation. The extent to which students assume responsibility for the acts that result in disciplinary measures as compared to the extent to which they see the causes as lying outside their control is the primary focus of this study. Though much of literature explains student misbehavior, the vast majority of these explanations cite factors beyond direct student control, thus overlooking the potential influence of free choices, perceptions of acts, and contexts in which these occur.

Matilda Butler. Dynamics of School Health Education in the Far West Laboratory Region: A Pilot Study. School health education represents a challenge for the 1980s. This project is designed to provide information on the needs, goals, programs, participants, materials, etc., of school health education in Northern California, Utah, and Nevada.

Information is gathered through interviews with key state personnel and questionnaires sent to school district personnel.

Paul R. Christensen. Educational Use of Microcomputers. This project summarizes the current state-of-the art on educational use of low-cost, high-capability, self-contained microcomputers; develops a taxonomy by which to characterize typical computer-augmented learning environments; and describes teacher perceptions of the "computer readiness" of students and the positive and negative factors in the learning environments.

Natividad DeAnda. Competencies of Leaders and Managers in Educational R&D. The study's goal is to produce an outline of competencies essential to successful management and leadership of educational projects, by analyzing job descriptions of managers and non-managers at the Laboratory for skill and knowledge areas utilized in their work. The study provides data for determining which competencies are considered essential to program management at the Far West Laboratory.

Jill S. Evenson. A Survey of Work-Related Attitudes of Professionals in Special Education. This study examines the attitudes toward work of teachers and administrators engaged in special education--persons who are in a position to exert strong influence on the developing work values of handicapped young persons. The study is seen as an exploratory step into needed research on work-related attitudes of handicapped young people and the effect on them of attitudes of their teachers.

J. Ronald Lally. Expanding Experiences and Employment for the Elderly Through Non-Center Based Family Child Care. This project is a needs assessment and feasibility study designed to investigate the possible creation of a system for delivering quality child care services and meaningful employment for the elderly in child care.

Chesca Piuma. Feasibility Study: Developing a Vocational Education Training Program for Severely Handicapped Adolescents and Young Adults. This study investigates the feasibility of developing five vocational education curricula for severely handicapped (trainable mentally retarded) adolescents and young adults (ages 13-21) in the employment areas of gardening, housekeeping, laundry, minor auto maintenance, and food services.

The Far West Laboratory Independent Research and Development Committee:

Paul D. Hood, Chair
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Kathleen Devaney
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The Program Committee of the Laboratory Board of Directors:

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ABSTRACT

This study was initiated to determine what specific competencies were essential to leading and managing educational projects in R&D at Far West Laboratory. Thirty Far West Laboratory project managers and 31 Far West Laboratory program staff were the subjects of the study.

The goal of the study was two-fold: first, to establish a profile of these identified competencies for use in planning the content and emphasis of the intern training program of the Women and Minorities Leadership Program in Educational R&D at Far West Laboratory; second, to prepare this profile for possible national dissemination and for use by other similar projects under the aegis of the National Institute of Education.

This list of competencies was derived from three source areas: those identified by known researchers in the field, those determined through the Hay System of job description ratings used at Far West Laboratory, and those arrived at through study of a self-report survey that compared the responses of project directors to those of R&D program staff.

A discriminate analysis of the Hay System ratings for R&D job descriptions at Far West Laboratory showed that three major variables accounted for most of the differences between project directors and program staff. These were: (1) freedom to act in decision making; (2) ability to handle diverse tasks in project management; and (3) possession of technical expertise applicable to R&D. If any one variable could differentiate project directors from program staff, it was managerial know-how. The competencies implied by the identified variables were developed and included in the survey questionnaire administered to most of the project managers and an equal number of program staff.

The findings of the self-report survey showed that project management jobs require significantly more competence in the following areas than do jobs of program staff: (1) supervision, (2) budget management, and (3) public relations/networking. The following categories of competencies were found to require a high level of proficiency by both project directors and program staff: (1) communications, and (2) documentation.

Competencies related to planning and evaluation were also found to be important, but less so than those mentioned above. Two categories of competencies of minimal importance to project management and to jobs of program staff were: (1) technical research skills, and (2) skills related to product development. These findings are of special importance for considering the content and design of leadership preparation in the field of educational R&D. The findings that technical skills are of little importance to successful program management contradict the traditional emphasis given by universities to development of these skills in preparation of R&D personnel.

Data relating the subjects' personal characteristics to their managerial status showed that in the high management positions at Far West Laboratory, there appear to be significantly more men than women, more white Americans than other ethnic groups, more subjects with doctorates with six or more years of experience in educational R&D administration than those with degrees less than a Ph.D.

ACKNOWLEDGMENTS

This is to acknowledge the efforts of the individuals who contributed to the completion of this study.

Mike Webb, an intern in the Women and Minorities Leadership Program at Far West Laboratory, surveyed the literature, wrote the initial draft of the literature review, and participated in the revision and culling of the survey competency list.

Fran Bairley, administrative assistant in the Women and Minorities Leadership Program, contributed significantly to reviewing the literature and to refining and culling the competency items for the survey, and assisted in editing and formatting the final report.

Rob Slaughter, an evaluation specialist in the Responsive Education Program, provided technical assistance in analysis of the data.

John Hemphill, Director of Far West Laboratory, provided effective counsel regarding the formulation of the survey instrument and analysis and interpretation of the results.

Daniel Stufflebeam, Ph.D., noted educational researcher, advised on sources of information pertaining to management competencies.

Desmond L. Cook, Ph.D., recognized expert in educational R&D management, shared unpublished documents and expressed interest and provided encouragement in the progress and outcome of the study.

Pennfield Jensen and Susan Weisberg, editors.

INTRODUCTION

Statement of the Problem and Historical Background

Currently there are no clear criteria for determining when a person possesses the competencies which would enable him or her to be a successful leader or manager in educational research and development. Reliable criteria would be a distinct asset to educational research laboratories and institutions, serving as an instrument to select potential managers and providing a well-focused training program for aspiring leaders in research and development.

Identification of the competencies needed for effective management of R&D projects would be especially applicable and useful to the more than 50 projects nationwide that have been funded to implement leadership programs for women and minorities in the field of educational R&D.

Presently, the basis for selection and promotion of staff personnel to managerial positions in the field is almost entirely dependent on professional judgment of people already in those roles. For example, the criteria for selection of Principal Investigators at Far West Laboratory consists of a review of previous experience in management of programs, evidence of an area of expertise in education, educational accomplishment, and a judgement about the candidate's personal potential by the selection committee. While this procedure has been relatively successful, it does not directly help the aspiring manager to learn what he or she may need to know to acquire and hold such a position.

Definition of Management in R&D

Several attempts have been made to identify the critical areas of management in educational R&D. This effort may be said to have begun with Blanchard and Cook's (1971) statement that research and development projects involve the application of competencies--distinct skills and knowledge--to accomplish what

are often complex and interrelated tasks and activities. They described project management as the systematic means of focusing and unifying efforts to plan and control variables of time, costs, and components. Cook (1971) provided a list of steps which compose the managerial process, and went on to discuss management as a means to systemize and integrate decisions, policies, and priorities. He then specified skills for effective management, such as problem solving, decision making, scheduling, and budgeting.

Schutz (1972) described the organization of tasks within an educational research and development center as requiring special competencies that were directly related to management. Hemphill's (1959) work establishing an objective base for appraising performance and salary differentials in industry is applicable to management in the R&D setting, in that the base consists of managerial competencies comprised of identifiable factors. He related such factors as decision making, analysis, organization, etc., to definite skills and knowledge needed in different roles, levels, and types of management within projects.

Factors Complicating the Study of R&D Competencies

Although there is some agreement as to the existence of specific competencies which enable a professional in R&D to function effectively as a manager, it is argued that an individual needs to possess all or a majority of management competencies in order to successfully manage an R&D project. Worthen (1975) noted that, since activities and tasks can be accomplished by a nonmanager, a team, or an organization of people, skills particular to management are: task definition, delegation, and supervision.

Increased specialization in various areas of research also makes it unlikely that an individual will possess all the skills required to manage a project. For example, the area of evaluation and statistical analysis requires extensive training and is best handled by a specialist. The manager's job would be to know

which questions to pose, how to interpret the data, how to coordinate efforts to obtain results, and how to present the outcome adequately.

The question of which competencies are essential is further complicated by the fact that agencies and institutions engaged in educational R&D may have markedly different management needs. The requirements of universities and those of laboratories and centers overlap, but they also differ enough to call for different competencies to function effectively in particular situations.

Project management in a university, on the one hand, according to Heathington, Cunningham, and Mundy (1978), requires competency in interdepartmental coordination, dealing effectively with issues of territoriality, and providing for student learning. On the other hand, federally supported laboratories and centers are usually funded to conduct specific educational missions on regional and national levels, and they require administrative and bureaucratic skills which differ from educational R&D competencies (Campbell et al., 1975).

In addition, the advent of federal, state, and local educational initiatives and new legislation often require new or revised sets of competencies for effective implementation of new projects. For example, increased concern for multiculturalism and pluralism in educational activities necessitates that management of staffs with a diversity of personnel, project activities, and procurement of resources be relevant to the subject area (Braithwaite, 1977).

Once there was evidence for a body of general, transferable, managerial skills, research efforts contributed to a generally recognized list of such competencies. The list was useful in planning and developing the competency profile of this study.

Hemphill's (1959) extensive competency list for management in industry consisted of 500 items. These were reduced to 95 by the Educational Testing Service. Although the area studied was industrial management, the competencies essential for effective supervision, budget management, public relations, and

planning are similar to those required for R&D management.

Cook, Kerns, and Damico (1970), of the Educational Program Center at the Ohio State University, made further noteworthy additions to the existing bank of competencies. They emphasize studying the particular needs of project management in the educational community at large.

The first large-scale study of educational R&D was made by Anderson et al. (1971), commissioned by the U. S. Office of Education (USOE). It identified functions, tasks, and competencies that are required of researchers, developers, disseminators, and evaluators. Persons selected as subjects for this study were engaged in exemplary research, dissemination, or evaluation activities in universities, educational laboratories and centers, and private research agencies. This effort preceded that undertaken by Worthen (1975) under the aegis of the American Educational Research Association. Worthen compiled a competency list of 266 items which apply to the general field of educational research and development.

Webster, a researcher who assisted Worthen in his initial study, later (1977) developed an extensive list of competencies for school district personnel in Dallas, which was derived from the original study by Worthen.

The Contribution of This Study Toward Identification of R&D Competencies

At this point, the question of what it takes to be an effective project leader and manager in educational R&D remains unanswered. Identification of essential skills needed to function successfully as a manager in educational R&D would help to answer this question.

The current study sought, through an examination of the jobs of project directors and program staff at Far West Laboratory to identify those competencies which are required by both project directors and program staff, and to provide a

list of those competencies which appear to be essential to educational R&D.

Specification of the competencies required to direct projects at Far West Laboratory would outline the skills that personnel seeking promotions to leadership and management in this field need to have. In support, Popham (1974) asserts that efforts to identify measurable management competencies are important for establishing distinct certification levels for research and development personnel. This idea is also supported and advanced by Gagné, who writes: ". . .the recognition of professional competence . . . helps to establish and to enhance the status of the profession among professional colleagues." (1975, p. 8.)

APPROACH TO THE STUDY

Methods and Procedures

Assumptions of the Study

To differentiate R&D Skills, it was assumed that some competencies required for project management differ from those required by project staff. To study the differences in job requirements, the sample of R&D professional staff was separated into two groups, project managers and nonmanagers (program staff).

The assumption is also made that the subjects surveyed in this study have reported and rated the competencies required in the performance of their jobs accurately.

Design of the Study

The two categories of R&D positions, management and nonmanagement, were studied by analyzing the results of the Hay System rating of jobs and by obtaining individual ratings from subjects through a self-report inventory.

In order to collect and analyze the data and to prepare the final report, it was necessary to develop an accurate survey instrument to measure competencies. This will be described in detail below.

The Sample

The unit of study was the population of R&D professionals at Far West Laboratory. The sample whose jobs were studied consisted of 30 project managers and 31 program staff (or nonmanagers). All could be categorized in four definable areas of educational R&D:

1. Dissemination
2. Technical assistance
3. Product development
4. Research

Instruments for Gathering Data

The Hay Job Rating System. Job evaluation under the Hay System begins with a job description (a "Questionnaire") developed by each employee in conjunction with his or her supervisor. This questionnaire explains (1) why a job exists (its general function and primary objective); (2) what kind of job it is (its role in an organization, its relation to other jobs and to external organizations); (3) its freedom of action (controls limiting the job); and (4) its impact and magnitude (how and to what extent the job affects the Laboratory).

Committees are selected to rate and to ascribe scores to jobs. Committees composed of well-regarded professionals from each salary level, department, sex, and ethnic background are trained to evaluate job questionnaires against standard criteria and to assign a point value for each criterion. The committees develop a Laboratory-wide, consistent value for a job by evaluating several dimensions in the domains of know-how, problem solving, and accountability. (See Appendix B for the scheme of the rating system.)

Know-how. This includes three dimensions: (a) Technical skills: does the job require only practical procedures or does it require advanced training and specialized techniques? (b) Managerial skills: does the job require integrating and harmonizing diverse functions? (c) Human relations skills: are courtesy and effectiveness sufficient in dealing with people on the job or does the job require a high level of motivating skills?

Problem solving. This examines two dimensions: (a) Thinking environment--the framework for solving problems; e.g., does the job decide how to follow policy or form new policies to meet new situations? (b) Thinking challenge--the types of problems presented by the job and the thought process required. Are the problem solving patterns repetitive or do they require adaptive or constructive thinking?

Accountability. "Accountability" is the effect of the job on the end results. The accountability level of a job is determined by evaluating three

dimensions: (a) Freedom to act: does the job follow prescribed procedures or is it limited by only the most general directives? (b) Impact magnitude: how big a change can the job make, and on what? (c) Contribution: often many jobs work toward the same accountability; how is this job related to that result?

Each job is evaluated holistically. A committee determines the rating for the combination of tasks according to specified criteria. Evaluation process only examines job content. No attempt is made to evaluate an individual employee's performance. Performance evaluation remains the responsibility of each supervisor.

This job rating system provided total and subscores in each of the three domains. The eight dimensions within each domain comprise a total of eleven measurable variables. Thus, the total of know-how, problem solving, and accountability scores were determined by these eleven variables.

Survey Questionnaire. The Survey Questionnaire was developed by selecting competencies previously identified by major researchers: Hemphill (1959); Worthen (1975); Cook (1971); Cook, Kerns, and Damico (1970); and Webster (1977).

A pool of 200 items was formed in six broad categories: management, evaluation, technical research skills, public relations, dissemination, and knowledge.

Additional items were developed on the basis of an analysis of the Hay ratings of jobs. This analysis determined which competency areas best discriminated between managers and nonmanagers.

Both the categories and the list of competencies were redefined and expanded to the ten categories described below. The redefinition resulted in production of the final survey instrument (see Appendix C) consisting of 166 items in ten categories. Two examples within each category are provided here. (Note that each item is responded to in three areas: (A) degree of competency; (B) frequency required; and (C) how related to your job.)

EXAMPLE OF ITEMS BY CATEGORY

SCALES	DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
	4 MUST BE ABLE TO DO	3 EASY ENOUGH TO DELEGATE	2 CAN RELY ON OTHERS	1 NOT NECESSARY TO DO	4 SEVERAL TIMES WEEKLY	3 SEVERAL TIMES QUARTERLY	2 ONCE/FEW TIMES YEARLY	1 NOT REQUIRED	4 ABSOLUTELY ESSENTIAL	3 IMPORTANT/NOT CRITICAL	2 NEGLIGIBLE IMPORTANCE	1 COULD DO WITHOUT
Supervision. (38 items)												
13. Define responsibilities of staff.												
32. Resolve employee work relationship problems fairly.												
Communications. (21 items)												
39. Use face-to-face communication to accomplish management tasks.												
59. Disseminate research findings through presentations, journal publications, research networks, newsletters, and other professional communications.												
Planning. (22 items)												
70. Estimate resources necessary to accomplish project tasks.												
77. Evaluate present trends and anticipate future needs in R&D.												
Evaluation. (14 items)												
91. Appraise results of project operations, analyze performance reports, and interpret data.												
93. Formulate a plan to evaluate the project.												
Product Development. (9 items)												
100. Assess latest technical developments for improvements of project services and/or products.												
102. Design programs to field-test new products, materials, or services.												
Public Relations. (7 items)												
107. Prepare and deliver presentations at professional conferences.												
108. Represent the project or the Laboratory to outside parent organization or institution.												
Budget. (14 items)												
113. Allocate appropriate amount of funds to various phases of work within the project.												
121. Administer line-item budget to ensure proper fund expenditure within project budget.												
Documentation. (18 items)												
128. Design system for recording project operations required for funding source.												
130. Prepare final reports required for the project.												
Technical Research Skills. (29 items)												
14[illegible]. Recognize theoretical assumptions underlying various statistical techniques.												
154. Apply specific experimental and quasi-experimental research designs.												
Networking. (4 items)												
165. Develop collaborative and interactive relationships with other related projects.												
166. Inform educational community about the project's services and products.												

The questionnaire was refined by deleting the obviously redundant items and those which did not appear to belong in their assigned categories. Eight R&D professionals reviewed the first draft to be sure the statements were clear. Many items were eliminated and others rewritten to produce the final list of 166 items.

To determine competencies required of each R&D job, the subjects were asked to answer three questions in response to each competency statement:

1. What is the level of mastery required?
2. How frequently do you use the competency?
3. How essential is this competency to your job?

Analysis of the responses provided the information needed to determine the final list of competencies and differences between those competencies required by project managers and those required by nonmanagers.

Analysis of the Hay System Data. Three kinds of analyses of the Hay Questionnaire data were used to identify the knowledge and skill areas that differentiate project managers from nonmanagers.

A step-wise discriminate analysis was used to identify which one or two variables accounted for the differences. A discriminate function analysis was used to determine which combination of variables accounted for the differences between the two groups. Multiple classification analysis was used to verify that project managers and program staff were accurately differentiated.

A cluster analysis of the Hay Questionnaire data was used to validate the identification of the two groups.

Analysis of the Survey Data. An item analysis was used to determine the reliability of items within the subscales.

A descriptive analysis showing the means and standard deviations for each item for the entire sample identified competencies essential to the entire sample of jobs in R&D.

A descriptive analysis of project manager and nonmanager responses provided a distribution expressed in raw numbers and percentages. The significance test using the Pearson correlation coefficient determined the significant differentiation between the two groups.

The total competency list was redefined by eliminating unreliable, undiscriminating items. This information was used to see if a relationship existed between the responses of the subjects and their personal characteristics, i.e., sex, ethnic background, education, experience in research, experience in R&D, and type of R&D project.

A final profile of competencies was determined by those items that met the following criteria:

- They were reliable.
- They differentiated between project managers and program staff (nonmanagers).
- They described an aspect of a competency category.

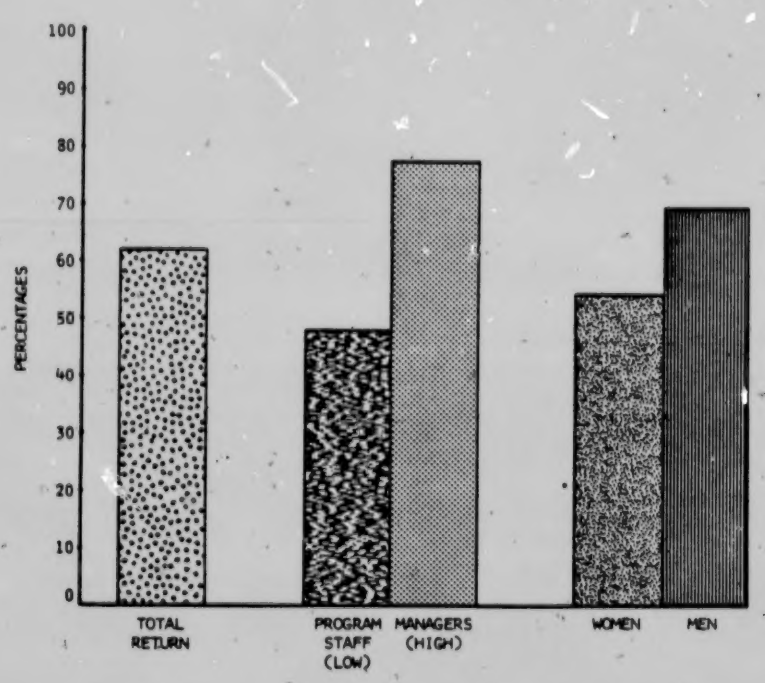
RESULTS AND DISCUSSION

The Sample

Survey questionnaires were sent to 30 project managers and 31 program staff. The graph below shows a 77 percent return from the project managers and 58 percent return from the program staff, with an overall return rate of 62 percent. The sample was thus 38 rather than the anticipated 61.

The sample was divided into high and low groups on the basis of the subjects' managerial scores, as determined by the Hay System, which identified 20 subjects with a high managerial rating (high group) and 18 with a lower managerial rating (low group).

PERCENTAGE RETURN OF QUESTIONNAIRES
BY MANAGERIAL STATUS & SEX



As the graph shows, subjects in the high managerial group returned significantly more questionnaires than did those in the low group. One explanation for the difference is that more subjects in the high managerial sample are committed to supporting the research of other programs.

Further inspection of job titles resulted in reassignment of three Principal Investigators to the low group and three program staff to the high group. This reassignment seems appropriate in view of the fact that some individuals not having Principal Investigator status are both supervising professional staff and managing a project, while several Principal Investigators are managing projects too small to require professional supervision.

Distribution of the sample according to personal characteristics of the subjects was also studied. As shown in Table 1, the majority of subjects in the high managerial category are white males who have relatively extensive experience in the general field of research, as well as in the special field of educational R&D, and who have attained an educational level of at least a doctorate. Two of the three black subjects are in the high managerial category while both Hispanics, one Asian, and one "other" are in the low group.

Distribution of low and high management subjects by the nature of the project in which they work shows that more high management subjects are from dissemination and research projects than those from other projects.

Table 1 follows.

TABLE 1

DISTRIBUTION OF SAMPLE ACCORDING TO PERSONAL CHARACTERISTICS AND MANAGERIAL RATING*

		HIGH	LOW
Managerial Status	Project Investigator	20	0
	Project Staff	0	18
Sex	Male	13	7
	Female	7	11
Ethnicity	White	18	13
	Black	2	1
	Hispanic	0	2
	Asian	0	1
	Other	0	1
R&D Project Type	Dissemination	6	1
	Tech. Assistant	4	8
	Research	9	7
	Prod. Development	1	2
Education	B.A	2	1
	M.A	2	10
	Doctorate	13	7
	Post-Doctorate	2	0
Years in Research Field	< 2	0	8
	2-4	7	7
	4-6	3	1
	6-10	3	0
	10+	7	2
Years in R&D for Education	0-3	1	4
	3-6	0	3
	6-10	5	8
	10+	14	3

*As determined by the Hay System rating.

Job Description Analysis

A brief explanation of a modification of the Hay Rating System that was made in this study will indicate the variables that were used in the analysis.

The Hay System specifies three major dimensions: (1) know-how, (2) problem solving, and (3) accountability. A refinement of the measures within these dimensions is necessary to pinpoint individual scores. The variables within each dimension are:

A. Know-how

1. Technical skills (technical expertise)
2. Managerial know-how
3. Human relations skills
4. Level within the cells defined by A1.

B. Problem solving

1. Thinking environment
2. Thinking challenge
3. Level within the cells defined by B1-2.

C. Accountability

1. Freedom to act
2. Magnitude
3. Impact on outcomes
4. Level within cells defined by C1.

The scores of each subject in the sample were determined by measures on eleven variables.

In order to perform the discriminate analyses, subjects in the sample were assigned to three groups: (1) Principal Investigators (PIs), (2) non-PIs with management responsibilities, and (3) nonmanagers (program staff). The analysis then determined what variables, if any, accounted for differences among the three groups.

Three types of procedures were used in this analysis: (1) step-wise discriminate analysis, (2) discriminate function analysis, and (3) multiple classi-

fication analysis.

Step-wise discriminate analysis. The analysis produced a list of predictors, which are presented in descending order of their power to predict the group membership. Seven significant predictors as determined by the Wilks's lambda criteria ($P<.05$) are:

A2 - Mangerial know-how

C4 - Freedom to act (fine measure)

C3 - Impact on outcomes

C1 - Freedom to act (gross measure)

B1 - Thinking environment (ranging from routine to abstract)

C2 - Magnitude (management of activities within a project)

A1 - Know-how (technical expertise)

Because each variable's effect on the score is extracted, each successive predictor is less and less potent. For this reason, the first three or four predictors are the most significant. In view of this, it is apparent that management know-how, freedom to act, and capacity to directly influence outcomes are characteristics which differentiated the Principal Investigator from the program staff in this analysis.

Discriminate function analysis. The discriminate function procedure uses all the eleven variables simultaneously to determine the combination which best discriminates between groups.

This analysis showed that the predominant and only significant function contained the following variables:

C1 - Freedom to act (gross measure)

C2 - Magnitude (management of diverse activities within a project)

C4 - Freedom to act (fine measure)

A1 - Know-how (technical expertise)

Both analyses showed that PIs and project managers were differentiated from program staff by variables related to the capacity to manage projects with diverse activities and large budgets without much guidance.

Multiple classification analysis. This procedure is used to validate the classification of the subjects into the three groups. After the discriminate functions have been generated, each individual's data are applied to the functions and the individual's group membership is predicted. The prediction is then compared to actual group designation to determine the accuracy of the original assignment. The results showed that 88.1 percent were correctly classified. In other words, only 11 percent of the cases were inaccurately rated, thus supporting the validity of the analyses made by the two procedures.

Cluster analysis. The cluster analysis is a further attempt to validate the assignment of individuals to the three groups. In this analysis, the eleven variables are plotted mathematically into an eleven-dimensional space for each individual. Geometric distances are then calculated between individual scores based on the positions of all eleven variables. Clusters are mathematically determined and the results of the groupings can then be compared with the assignments used by the Hay System.

This analysis clearly showed the managers in one cluster and the nonmanagers (program staff) in another. The result attests to the credibility of the Hay Rating System and the consistency of rating by the committees involved.

Implications. The above analyses were performed to identify the knowledge and/or skill areas which differentiate the managers from the nonmanagers. The step-wise discriminate analysis and the discriminate function analysis both identified differences in skills and knowledge between managers and nonmanagers in the accountability and know-how domains.

A multiple classification and a cluster analysis was performed to validate

that the two samples of managers and nonmanagers, as determined by their Hay scale scores, were, in fact, different from each other with respect to skills and knowledge. The skills and knowledge that accounted for the differences between managers and nonmanagers were related to the "accountability" and "know-how" domains. These results guided selection of the previously identified competencies and development of additional ones to form a managerial competency survey questionnaire. The project managers and nonmanagers participated in the survey by completing the questionnaire. The results of the survey are presented in the following subsections.

Results of the Managerial Competency Survey

The survey consisted of a list of 166 items on eleven successive pages. Each subject was instructed to rate his or her current job in regard to each item in terms of:

A: the level of competency that the job required;

B: how frequently the competency was actually used;

C: the extent to which the competency was essential to the job.

The questionnaire produced extensive data. A system for synthesizing the three souces of information was devised to isolate the most important ratings in the three categories (A, B, C described above). The criterion used to condense this information for presentation here is described in the next subsections.

Criterion for identifying essential competencies. The analysis of the survey data was limited to descriptive statistics. Rigorous significance testing was ruled out due to the relatively small sample size and the insufficient reliability of the instrument. For example, a factor analysis would have required that the number of subjects and the number of items be roughly equivalent. The sample size being 38 and the item number 166 made such an analysis impractical.

To allow for descriptive analysis, the great volume of information was reduced by combining the results of two categories of ratings which were highly correlated and disregarding the frequency category. A correlation analysis showed a .97 correlation between the rating of the level of proficiency to perform the job and the rating of how essential the competency was to adequate performance. The subjects' ratings of the requirements of their jobs within these two categories were almost identical.

On the other hand, the frequency with which a competency was needed on the job did not correlate with either the level of competency needed or how essential it was to the job. This seems understandable in view of the fact that, for example, proposal writing is a competency absolutely essential to the job of a Principal Investigator but required only once a year, whereas memoranda writing is not as essential but is used frequently. Consequently, frequency was not an effective differentiator of managers and nonmanagers and is not presented in the results and discussion here.

Items were identified as "essential" to either project managers or program staff <u>if more than 70 percent</u> of the subjects in either group rated them as <u>both</u> essential and requiring high competency.

To give importance to both categories, items which were rated by more than 70 percent of managers as essential to the job but which rated as not requiring high competency were considered as "delegatable" competencies. This criterion identified competencies which were <u>essential</u> to program managers but which <u>could</u> be assigned to others (called "Essential, can delegate"; see Table 2).

In order to identify those competencies that were unique to project management, a Pearson correlation coefficient provided a significant test at the .05 level.* That is, if subjects in the project management group rated a competency

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*The significance test for a correlation coefficient in which a dummy vector is used for group identification is identical to a T-test.

significantly higher than those in the nonmanagement group, the item was considered unique to project management.

Reliability of the items was determined by correlating item to the subscore. The only subscores with a high percentage of reliable items were Budget Management and Technical Research Skills. The implication of the small number of reliable items is that some of the items may have been redundant or superfluous. The implication of the low number of reliable items is that fewer could have been used to sample the competency category. The problem of low reliability to identification of competencies essential to managers and nonmanagers was circumvented by using item percentage scores, as described above.

Findings

Essential competencies. Eighty-eight of the total 166 items were found to be essential to project management jobs. The majority of the competencies were in six of the ten categories: supervision, communications, networking, documentation, public relations, and budget. Only 39 of the 166 items were essential to nonmanagement staff. It is worth noting that two categories of competencies which rated of little or no importance to project management were Technical Research Skills and Product Development. These findings are consistent with those of the discriminate analysis of the Hay System ratings.

Table 2 follows.

TABLE 2

SUMMARY OF COMPETENCIES ESSENTIAL TO PROJECT MANAGERS AND PROGRAM STAFF

CATEGORIES	No. of Items	Re-lia-ble Items	No. Unique to Proj. Mgmnt. (<.05)	%	No. Essential to & Requiring High Competency in Proj. Mgmnt.	%	Essen. can dele-gate	No. Essential to & Requiring High Competency in Proj. Mgmnt.	%	No. Unique to Program Staff
Supervision	38	4	16	42%	27	71%	1	7	18%	2
Communications	22	4	1	5%	16	73%	1	14	67%	1
Planning	24	8	6	25%	10	40%	2	6	25%	2
Evaluation	11	2	1	9%	4	36%	0	3	27%	1
Product Development	10	5	0	---	0	---	0	0	---	-
Public Relations	6	0	1	17%	3	50%	0	2	33%	1
Budget	14	13	9	64%	11	79%	3	0	---	2
Documentation	8	0	0	---	5	63%	0	6	75%	0
Technical Research Skills	29	20	0	---	1	3%	1	0	---	-
Networking	4	1	3	75%	3	75%	0	0	---	0
TOTALS	166	65	37	22%	81	48%	8	39	23%	10

A category is significant when 50 percent or more of the items are essential and require a high level of competency. These categories are circled on the table.

The competencies essential to program staff are in only two categories--Communications and Documentation. However, these are not exclusively needed by program staff; they are also found essential to managers.

Competencies unique to management. Thirty-seven competencies in the areas of Budgeting and Networking seem to be within the province of management. Supervision is also a category which is close to being exclusive to management positions.

Reliability. The categories of Budgeting and Technical Research Skills have closely related items within their respective categories. The highest number of reliable items were found in these two categories. They are categories which could be said to have a consistent sampling of their specified area.

Discussion of Competency Categories

The findings are presented in detail on the following pages. The items which were found to be essential to project management and program staff are presented by category. Each competency is written as it appeared in the survey questionnaire, with notations regarding which group rated it as essential. The implications of the identified competencies for management in R&D are discussed.

ITEMS ESSENTIAL TO SUPERVISION (Part 1)	PROJECT MANAGEMENT COMPETENCIES: UNIQUE AT <.05	ESSENTIAL/MUST DO	ESSENTIAL/CAN DELEGATE	ESSENTIAL PROGRAM/STAFF COMPETENCIES	SUBSCALE RELIABILITY
SUPERVISION — Essential to Managers N:27; Essential to Nonmanagers N:13					
1. Assess employee performance, work schedule, and expenditure rate of project contract	X	X			
2. Set priorities for project tasks		X		X	
3. Determine amount of time for completing project tasks with consideration to staff capabilities		X			
4. Make necessary tradeoffs between scheduled deadlines, budget allocations, and personnel to accomplish project goals	X	X			X
5. Participate as a contributing team member on laboratory committees	X	X			
6. Establish means to acknowledge staff members' accomplishments as part of the reward system in your project	X	X		X	
7. Confront and/or dismiss malperforming personnel	X	X			
8. Structure meetings relevant to staff concerns and project needs				X	
9. Train and develop personnel to perform project tasks				X	
10. Plan, coordinate, and control activities of project personnel		X			
11. Establish lines of authority for staff supervision		X			
12. Assign personnel to specific project tasks according to the strengths of each person		X		X	
13. Define responsibilities of staff		X		X	X
14. Create a safe climate and procedure for eliciting staff input regarding project progress	X	X			
17. Establish project administrative policies, procedures, and guidelines for staff operation	X	X			
20. Assign jobs to subordinates with clear identification of objectives, tasks, and responsibilities	X	X			
Sub Totals	8	14	0	6	2

ITEMS ESSENTIAL TO SUPERVISION (continued) (Part 2)	PROJECT MANAGEMENT COMPETENCIES				
	UNIQUE AT <.05	ESSENTIAL/MUST DO	ESSENTIAL/CAN DELEGATE	ESSENTIAL PROGRAM/ STAFF COMPETENCIES	SUBSCALE RELIABILITY
SUPERVISION (cont'd) — Essential to Managers N:27; Essential to Nonmanagers N:13					
21. Determine salary increases based on assessment of job performance	X	X			
22. Monitor subordinates' activities by using regular reporting and review procedures		X			
23. Determine need for reassigning staff to meet project deadlines	X	X			X
24. Enforce rules and regulations essential for project operation	X	X			
25. Assess employee attitudes toward their work		X			
29. Establish procedures for communicating information to staff		X		X	
30. Review and evaluate employee effectiveness	X	X			X
31. Provide constructive feedback and take corrective action when necessary	X	X			
32. Resolve employee work relationship problems fairly	X	X			
33. Interpret and communicate organizational policy to subordinates	X	X			
34. Select staff with actual or potential skills for performing project tasks	X	X			
35. Organize team efforts based on professional abilities and personalities of staff members		X			
37. Establish framework for resolving problems and conflicts affecting task performance		X			
Sub Totals from Previous Page	8	14	0	6	2
TOTALS:	16	27	0	7	4

Discussion of Supervision Competencies

The results presented on the preceding pages in Part I, show that the project manager is largely (but not solely) responsible for creating a framework within which program staff will work. Competencies unique to the manager are: policy making (Item 17), assigning tasks (Item 12), providing for staff input (Item 14), assessing performance (Item 1), giving credit (Item 6), rescheduling personnel and reallocating funds to accomplish project goals (Item 4), and confronting malperforming staff (Item 7). The manager also sets the priorities (Item 2), establishes lines of authority (Item 11), determines time allocation (Item 3), and coordinates (Item 10).

Some program staff assume some of these responsibilities (see fourth column), but only to the extent that they assist in the following functions: setting priorities (Item 2), defining jobs (Item 13), assigning tasks (Item 12), providing for training (Item 9), and supporting successful efforts by other project staff personnel (Item 6). The fact that both managers and nonmanagers perform items 2, 6, 9 and 12 suggests that more of this work could be delegated to the project staff.

The competencies unique to management in Part 2 focus on selecting staff, communicating policy, assessing performance, and resolving problems. Of these management competencies, only one is shared with project staff (Item 29).

The logical sequence of the competencies in this set is: staff selection (Item 34), teamwork organization (Item 35), communication of policy (Item 33), establishing communication (Item 29), interpreting policy (Item 25), provision of feedback (Item 31), salary determination (Item 21), provision of a framework for resolving problems (Item 37), and resolving problems (Item 32).

In view of the management content in these competencies--27 items essential to managers versus 7 to program staff--it is clear why this section discriminated between management and program staff.

ITEMS ESSENTIAL TO COMMUNICATION Essential to Managers N:16 Essential to Nonmanagers N:14	PROJECT MANAGEMENT COMPETENCIES				
	UNIQUE AT .05	ESSENTIAL/MUST DO	ESSENTIAL/CAN DELEGATE	ESSENTIAL PROGRAM SUPT COMPETENCIES	SUBSCALE RELIABILITY
39. Use face-to-face communication to accomplish management tasks		X		X	
40. Reply appropriately to all correspondence related to the project			X		
41. Use personal contact for maintaining professional relationships		X		X	X
42. Contact and communicate with public and private agency personnel		X		X	
43. Evaluate or critique written/oral presentations		X		X	
44. Engage in effective oral communication with project staff		X		X	X
47. Obtain and use feedback from different sources (staff members, supervisors and/or peers) to assess project progress		X		X	
48. Motivate others to accomplish project objectives		X		X	X
49. Revise and rewrite articles, project reports, parts of proposals, and other project documents		X		X	
50. Respond extemporaneously to oral questions during meetings or presentations		X		X	
51. Interpret technical content or research data to professionals, parents, and students		X		X	
52. Articulate staff problems to a supervisor or staff members for discussion and solution		X		X	
53. Provide a written description or explanation of project goals, activities, and products				X	
55. Articulate project goals to administration and staff		X		X	
56. Write on technical subjects in style appropriate to audience addressed		X		X	
57. Assist staff to identify their roles in the project operation and how their activities contribute to the accomplishment of project objectives	X	X			X
58. Communicate results of research or evaluation studies to staff or administration		X			
59. Disseminate research findings through: presentations, journal publications, research networks, newsletters, and other professional communications	X	X			
TOTALS:	2	16	1	14	4

Discussion of Communication Competencies

Apart from Items 48 (motivation of staff) and 57 (identification of roles), the other 13 items are clearly related to effective communication. Items 48 and 57 really belong in supervision. The commonality of the items indicate that communication skills (speaking, writing, presenting, articulating, etc.) both are essential to and require a high level of competency from project managers and program staff. None of the skills in this category, except for Item 57, is unique to one group or the other. This outcome should be expected in view of the nature of educational research, which requires the ability to communicate and disseminate information at all levels.

ITEMS ESSENTIAL TO PLANNING	PROJECT MANAGEMENT COMPETENCIES				
	UNIQUE AT <.05	ESSENTIAL/MUST DO	ESSENTIAL/CAN DELEGATE	ESSENTIAL PROGRAM STAFF COMPETENCIES	SUBSCALE RELIABILITY
PLANNING — Essential to Managers N:10; Essential to Nonmanagers N: 6					
60. Prepare project proposals for funding	X	X			
61. Negotiate the final project contract with the funding source	X	X			
63. Estimate personnel requirements necessary to implement the project		X			X
65. Write proposals within defined specifications, i.e., RFPs		X		X	X
66. Establish procedures for implementing decisions	X	X			
67. Identify and assign tasks for initiating the project		X		X	
69. Plan and implement a system for project documentation			X		
70. Estimate resources necessary to accomplish project tasks			X		X
71. Estimate time required for completion of each task				X	
74. Make up and use project task-event calendar or flow chart to incorporate: project start date, task milestones, and completion date				X	
76. Outline steps needed to reach project objectives		X		X	
78. Develop new business by writing proposals or expanding the project	X	X			
85. Keep up-to-date information on funding by reading relevant sources of information, maintaining contact with private and federal agencies, and reviewing current RFP's and grant competitions	X	X			
86. Investigate current methodologies and instructional theories to adapt to specific project needs				X	
89. Estimate resources and time necessary to prepare proposals for funding		X			X
TOTALS:	5	10	2	6	4

Discussion of Planning Competencies

Five competencies were unique to management: preparing proposals (Item 60), negotiating contracts (Item 61), establishing procedures for implementation (Item 66), developing new business (Item 78), and keeping up to date on sources of funding (Item 85).

It appears that competencies such as relating methods and theory to project needs (Item 86), identifying tasks (Item 67), estimating time for task completion (Item 71), making up task calendars (Item 74), and outlining steps to reach objectives (Item 76) are in the domain of program staff.

Only two tasks are labled as "essential/can delegate": planning project documentation (Item 69), and estimating resources (Item 70). It appears that project management focuses its attention on administrative planning rather than on day-to-day implementation.

ITEMS ESSENTIAL TO TECHNICAL RESEARCH	PROJECT MANAGEMENT COMPETENCIES				
	UNIQUE AT .05	ESSENTIAL/MUST DO	ESSENTIAL/CAN DELEGATE	ESSENTIAL PRIMARY STAFF COMPETENCIES	SUBSCALE RELIABILITY
TECHNICAL RESEARCH SKILLS — Essential to Managers N: 1; Essential to Nonmanagers N: 1					
134. Interpret data to extract all relevant information		X	X		
138. Apply statistical regression techniques				X	
TOTALS:	0	1	1	1	0

Discussion of Technical Research Competencies

Of the 29 technical research competencies originally included in the survey questionnaire, only two were identified by either managers or program staff as essential to their work. The items in this category were also found to be highly reliable.

It is clear that technical research skills as defined in this profile are unimportant to work performed in R&D by the subjects. This is a surprising result, in view of the fact that the very title "educational R&D" includes the term "research." The finding is consistent, however, with the fact that management skills, such as supervision, planning, network/public relations, and budget management were found to be critical to R&D managers. Results of this section imply that technical research skills are left to a few specialists hired particularly to perform this type of work.

ITEMS ESSENTIAL TO EVALUATION	PROJECT MANAGEMENT COMPETENCIES: UNIQUE AT <.05	ESSENTIAL/MUST DO	ESSENTIAL/CAN DELEGATE	ESSENTIAL PROGRAM STAFF COMPETENCIES	SUBSCALE RELIABILITY
EVALUATION — Essential to Managers N: 4; Essential to Nonmanagers N: 3					
84. Adhere to terms of project contract while assuring quality services or production		X		X	
87. Evaluate new information or materials (new products, programs, or research evidence)				X	
88. Recognize significant deviations from the project plan		X		X	
91. Appraise results of project operations, analyze performance reports, and interpret data	X	X			
95. Identify factors which contribute to the accomplishment of project objectives and outcomes		X			X
TOTALS:	1	4	0	3	1

Discussion of Evaluation Competencies

These items were rated as essential and requiring a high level of competencies: where to contract and assure quality services (Item 84), recognition of deviations from the plan (Item 88), appraisal of project operations (Item 91), and identification of factors which contribute to project objective accomplishment (Item 95.)

There was little, if any, commonality with competencies required by program staff.

ITEMS ESSENTIAL TO PUBLIC RELATIONS/NETWORKING	PROJECT MANAGEMENT COMPETENCIES: UNIQUE AT .05	ESSENTIAL/MUST DO	ESSENTIAL/CAN DELEGATE	ESSENTIAL PROGRAM STAFF COMPETENCIES	SUBSCALE RELIABILITY
PUBLIC RELATIONS — Essential to Managers N: 6; Essential to Nonmanagers N: 2					
107. Prepare and deliver presentations at professional conferences		X		X	
108. Represent the project at the laboratory to outside parent organization or institution		X			
109. Develop an alliance with leading researchers and consultants to promote project visibility	X	X			
111. Work with public school, university, state, or federal agency personnel in collaborative effort to achieve project objectives				X	
NETWORKING					
164. Determine how project findings can be made available to educational practitioners	X	X			
165. Develop collaborative and interactive relationships with other related projects	X	X			X
166. Inform educational community about services and products of project	X	X			
TOTALS:	4	6	0	2	1

Discussion of Public Relations/Networking Competencies

These two categories are presented in combination because they seem highly interrelated. Project managers rated more competencies as essential than did nonmanagers in both of these categories. The competencies sampled by these items are: informing the educational community (Items 107, 166), and collaborating in developing alliances with other organizations and institutions (Items 109, 165).

Program staff seemed to be involved only in making presentations and working directly with schools and outside institutions.

ITEMS ESSENTIAL TO BUDGET MANAGEMENT	PROJECT MANAGEMENT COMPETENCIES: UNIQUE AT <.05	ESSENTIAL/MUST DO	ESSENTIAL/CAN DELEGATE	ESSENTIAL PROGRAM/STAFF COMPETENCIES	SUBSCALE RELIABILITY
BUDGET — Essential to Managers N:11; Essential to Nonmanagers N: 0					
112. Determine budget to distribute resources for project duration by calculating all elements of cost (staff, consultants, supplies, overhead, etc.)	X	X			X
113. Allocate appropriate amount of funds to various phases of work within the project	X	X			X
114. Operate within constraints on expenditure schedules and rates imposed by federal, state, and/or local regulations	X	X			
116. Use budget review procedure (e.g., monthly printouts) to monitor project expenditures		X	X		X
117. Justify budget expenses in project operation		X			X
118. Explain discrepancies between planned budget and actual expenditures	X	X			X
119. Prepare annual budget of at least $100,000	X	X			X
120. Accurately estimate long-range solvency of the program	X	X			X
121. Administer line-item budget to ensure proper fund expenditure within project budget	X	X	X		X
123. Calculate actual operating project budget to include all fixed and flexible cost elements	X	X	X		X
125. Adjust scope of work with funding sources as necessary	X	X			X
TOTALS:	9	11	3	0	10

Discussion of Budget Competencies

This category of competencies was both highly reliable and discriminating between project managers and program staff. Eleven of the original 14 competencies were found to be essential and to require a high level of competency on the part of project managers. The fact that none of the competencies was judged essential to program staff clearly indicates that budget management is a project director's province.

The sequence of competencies is most logically organized in the following way: budget preparation (Item 119), distribution of resources (Item 112), allocation of funds to phases of implementation (Item 113), operating within budget constraints (Item 114), administration of line-items (Item 121), calculation of operations and monitoring with review (Items 123, 116).

This sequence is followed by another related to project administration: decision making, i.e., explaining discrepancies and justifying expenditures (Items 117, 118); adjusting the scope of work to stay within the budget (Item 125); and planning and estimating the long-range solvency of the program (Item 120).

ITMES ESSENTIAL TO DOCUMENTATION	PROJECT MANAGEMENT COMPETENCIES				
	UNIQUE AT <.05	ESSENTIAL/MUST DO	ESSENTIAL/CAN DELEGATE	ESSENTIAL PROGRAM STAFF COMPETENCIES	SUBSCALE RELIABILITY
DOCUMENTATION — Essential to Managers N: 5; Essential to Nonmanagers N: 6					
126. Report regularly to higher level on project progress		X		X	
127. Prepare written technical progress reports		X		X	X
130. Prepare final reports required for the project		X		X	
131. Synthesize or summarize project progress		X		X	
132. Edit own and others' writing to include in project records and/or reports				X	
133. Write clear technical reports on planning, research, or evaluation of the project		X		X	
TOTALS:	0	5	0	6	1

Discussion of Documentation Competencies

Because the list of items here is short, it is easy to discern that the focus is on summarizing and synthesizing project progress in the form of reports of various kinds (Items 131, 130, 127, 126). The remaining two items are focused on preparation of technical reports and editing skills (Items 132, 133).

Almost all of these competencies are shared between project management and program staff. Although not stated, it seems apparent that much of the documentation is a collaborative effort between managers and program staff.

Competency profile and characteristics of the subjects. Table 3 represents information intended to facilitate observations regarding the relationships between the characteristics of the subjects in the study and the competency requirements of their jobs. The competency profile consists of the ten catagories of competencies shown across the top of the table. The characteristics of the subjects (in the left column) are those derived from the information obtained from the demographic data form completed by each individual. (Refer to following page for Table 3.)

Examination of the competency profile (Table 3) again shows that the competencies which are essential and require a high proficiency level (marked by an asterisk) are those in: supervision, communication, planning, budget management, and networking.

The competencies which were rated as important but not critical, or that could be delegated are in evaluation, public relations, and documentation. Both product development and technical research skills were rated as of negligible or no importance.

The means of items that were identified as reliable, as determined by an item total subscore correlation, are presented in the table cells. The mean scores for each competency category reflect ratings made by the subjects identified in the first column. Note that each competency category is further divided into high and low managerial groupings as determined by the Hay rating system.

The scores represent a rating of competencies based on how essential they are to the job of the subjects. The rating scale ranges from one through four as follows:

1) Could do without
2) Negligible importance
3) Important/not critical
4) Absolutely essential

TABLE 3

RELATIONSHIP BETWEEN COMPETENCY PROFILE AND CHARACTERISTICS OF THE SUBJECTS

CHARACTERISTIC	NO.	*SPRVSN. N: 14 H	*SPRVSN. N: 14 L	*COMM. N: 5 H	*COMM. N: 5 L	*PLANNING N: 10 H	*PLANNING N: 10 L	EVAL. N: 5 H	EVAL. N: 5 L	PROD. DEV. N: 5 H	PROD. DEV. N: 5 L	PUB. REL. N: 2 H	PUB. REL. N: 2 L	*BUDGET N: 13 H	*BUDGET N: 13 L	DOCUMENT. N: 2 H	DOCUMENT. N: 2 L	TECH. RES. N: 20 H	TECH. RES. N: 20 L	*NETWORK. N: 3 H	*NETWORK. N: 3 L
SEX:																					
Male	20	3.9	2.8	No. Diff.		3.5	3.0	3.0	3.0	No. Diff.		3.2	1.7	4.0	3.3	No. Diff.		2.7	2.1	3.7	2.9
Female	18	3.8	3.1	M: 3.7		3.3	2.9	3.3	2.8	M: 2.8		2.9	2.5	4.0	3.0	M: 3.0		1.8	2.1	3.7	3.1
ETHNICITY:																					
White Amer.	31	3.8	2.9			3.4	2.9	3.2	2.8	No. Diff.		3.0	2.3	3.7	2.3			2.4	2.4	3.7	3.0
Black Amer.	3	3.7	3.7	No. Diff.		3.7	3.7	2.6	3.8	M: 2.8		3.5	3.0	3.5	2.9	No. Diff.		2.7	2.3	4.0	4.0
Hispanic	2	-	3.9	M: 3.7		3.9	3.9	-	3.8	-	3.5	-	2.5	-	3.7	M: 3.0		-	3.2	-	3.8
Asian	1	-	2.2			-	1.6	-	2.0	-	2.0	-	1.0	-	1.6			-	1.6	-	2.0
Other	1	-	2.2			-	1.7	-	2.0	-	2.0	-	.5	-	1.5			-	1.7	-	2.0
ED. RESEARCH:																					
0-3 years	5	4.0	2.8	No. Diff.		3.4	3.0	No. Diff.		3.8	3.0	No. Diff.		3.5	2.9	No. Diff.		2.0	2.2	No. Diff.	
3-6 years	3	-	3.2	M: 3.7		-	3.0	M: 3.1		2.8	3.3	M: 2.7		-	2.7	M: 3.8		-	2.5	M: 3.8	
6-10 years	13	3.8	2.9			3.6	2.8			-	1.9			3.2	2.0			1.8	2.5		
10+ years	17	3.9	3.1			3.5	3.2			2.5	3.0			3.3	2.7			2.6	2.2		
EXP./R&D ADMINISTRATION:																					
None	2	-	1.6			-	1.4			-	2.5	-	1.2	-	1.3			-	2.6		
1-2 years	5	-	3.3	No. Diff.		-	3.1	No. Diff.		-	2.8	-	2.0	-	3.0	No. Diff.		-	2.4	No. Diff.	
2-4 years	14	4.0	3.3	M: 3.7		3.5	3.3	M: 3.1		3.0	3.3	3.1	2.5	3.4	2.3	M: 3.0		2.6	2.7	M: 3.8	
4-6 years	4	3.7	3.6			3.5	3.2			2.5	3.8	3.1	2.5	3.3	3.5			2.1	3.0		
6-10 years	3	3.6	-			2.6	-			2.0	-	2.5	-	2.7	-			1.6	-		
10+ years	9	3.8	2.8			3.8	2.8			2.6	1.6	3.8	1.7	3.5	2.2			3.1	2.3		
EDUCATION:																					
B.A.	3	4.0	2.6	No. Diff.		3.5	2.6	No. Diff.		2.6	1.2	No. Diff.		3.2	2.2	No. Diff.		1.4	2.5	4.0	2.3
M.A.	12	3.7	2.7	M: 3.7		3.2	2.7	M: 3.1		2.2	3.0	M: 2.7		3.3	2.2	M: 3.0		1.4	2.0	3.8	2.9
Doctorate	20	2.8	3.3			3.5	3.3			2.6	2.9			3.4	2.8			2.7	2.8	3.7	3.4
Post- Doc.	2	3.8	-			3.7	-			3.2	-			3.2	-			3.0	-	4.0	-
PROJECT TYPE:																					
Dissem.	7	3.8	3.5	No. Diff.		3.4	3.0	No. Diff.		2.2	3.0	No. Diff.		3.2	3.7	No. Diff.		2.0	2.2	No. Diff.	
Tech. Ass't	12	3.7	3.1	M: 3.7		3.6	3.2	M: 3.1		2.5	3.1	M: 3.0		3.4	2.5	M: 3.0		2.4	1.9	M: 3.8	
Research	16	3.9	2.7			3.5	2.5			2.8	2.4	3.0	2.5	2.8	2.2			2.7	2.6		
Prod. Dev.	3	4.0	3.8			3.4	3.6			3.8	3.8	3.0	2.7	3.5	2.6			2.0	3.8		

Rating scores of 2.5 or less indicate that the competency is of negligible importance to adequate performance of the job.

Inferences regarding the relationship between the characteristics of the subjects and the competencies required of their jobs are based on comparative observations of the mean rating scores. The standard deviations are not provided because the small size of most of the samples precluded statistical significance testing. The rule for comparing the scores is based on the nature of the scale. Ratings of 2.5 or less were considered of negligible importance to the job. Ratings that exceeded 3.5 were considered to be definitely essential to the job and thus were identified as a high management position competency.

Using this rationale, examination of the competency profile across the top of Table 3 again shows that those which are essential and require a high proficiency level (marked by an asterisk) are those in: supervision, communication, planning, budget management, and networking.

Discussion

The discussion of results shown on the table will focus on the characteristics of the subjects in relationship to the competencies required by their job positions as rated by the Hay Rating System (H and L in the columns).

Sex differences. There appear to be no differences in the jobs occupied by men and women. Differences in the job rating are due more to whether the jobs are rated high or low on the managerial know-how scale.

Ethnicity. There were no discernible ethnic differences between subjects in the high group. However, in the low group there were distinct differences between the subgroup labeled "white American" and those labeled "black" and "Hispanic American." Black and Hispanic subjects in the low group consistently rated their jobs in all categories of the profile as having high management requirements. It may be that these subjects have been misclassified in the low

management group when their jobs, in fact, require high management competency.

The one Asian subject shows a lower rating across the profile than any of the other ethnic groups. It is true to say that this person and the one classified as "Other" do hold positions which require lower competencies, but it is not advisable to make inferences about either of them as an ethnic group.

Years in educational research. The difference between subjects with few and many years in educational research is not apparent. Differences between the subjects are due to their professional position and corresponding rating as managers.

Experience in educational R&D administration. This characteristic differs from the one above in that this one specifies experience in educational R&D administration versus years in educational research. The subjects with no experience in this category rated their jobs consistently lower across the profile than did the others. There was a negligible difference between subjects with one year or more experience and those with two or more years of experience in R&D administration.

There was greater dfiference between subjects in the low and high management groups who had ten or more years experience than between subjects in both groups who had ten or more years experience and those who had less than ten years experience. Again, the difference here seems to be due mainly to whether the subjects' jobs were rated as high or low. Those subjects in the high group with ten or more years experience rated the categories of public relations and budget management as significantly more important to their jobs than did those in the low group having the same number of years experience in R&D.

Education. Again, differences seem to be due primarily to the grouping into low and high managerial groups rather than to the level of education achieved.

An exception is the competency categorized as technical research skills, which those with doctorate and post-doctorate experience rated higher than subjects with master's or bachelor's degrees.

Project type. There were no differences across the profile which could be attributed to the type of project in which subjects were employed. This was surprising, in that subjects in research-oriented projects were expected to rate technical research skills as important or essential to their work. On the contrary, they rated them as negligible or unnecessary.

Sex comparisons within characteristics of subjects. A finer analysis was conducted to see if there were differences between subjects of different sexes within the other categories of characteristics. For example, ethnic groups were further divided into male and female to note differences within the ethnic category. This sex comparison analysis showed no significant differences.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The competencies essential to the management of R&D projects at Far West Laboratory and requiring a high level of skill have been identified as being in six main categories: (1) supervision, (2) communications, (3) budget management, (4) documentation, (5) networking, and (6) public relations. The last two categories can be combined under the single heading of public relations/networking.

These findings are in agreement with the results obtained by an analysis of the Hay System job ratings. Discriminate analysis showed that project management and program staff jobs were differentiated primarily by the level of managerial know-how and accountability they required. These competencies for managing projects implied skills in supervision, budget management, documentation, and public relations.

The findings are counter to the general belief of universities and other institutions which prepare individuals for the research professions that technical skills in research are of overriding importance. The findings show that none of the Far West Laboratory employees considered technical skills as essential to their jobs, either as project directors or program staff.

Further analysis was made to determine whether employees with ten or more years experience in research (with a minimum of a doctoral education and/or working in jobs described as research) would give technical research skills any more importance. They did not; this group, too, rated technical research skills as having negligible or little importance in their work.

This is not to say that technical reserach skills are not essential. Rather, they may be of highly specialized value in those types of programs that place a heavy emphasis on research. A possible reason for the low importance

given to this area may be that competence is essential to conduct an R&D program, but responsibility can be delegated to an individual especially trained in the technical research field.

The categories to which the competencies are common to both project managers and to program staff are communications and documentation.

The fact that substantial overlap existed in only two categories out of ten indicates that this survey questionnaire was appropriately geared to assessing the competencies of project managers. The reasons for the overlap in these two areas (communication and documentation) seems logical. First, well-developed communication skills are required of all professionals in the field of research and development. Second, the overlap in documentation might be explained by the fact that recording and collecting program progress information is done by the entire staff.

The factor that accounted for differences in ratings on the competency profile was job position in the management/program staff dimension. Characteristics of the subjects, such as years in research, type of project, and sex, were found not to be associated with the difference in the profiles, with only one exception--ethnic identification. Both black and Hispanic Americans in the low management group indicated that the competencies and level of proficiency required by their jobs were related more to the high management group than to the low. These may be the subjects previously noted to be misclassified by the Hay Rating System.

The statistics describing the subjects of the study indicate that the characteristics associated with high management positions are six years or more in the field of R&D, a doctoral degree, and jobs in the field of research and dissemination.

There are more men than women in high managerial positions and more subjects identified as being of white American ethnicity than there are of black, Hispanic, Asian, or other American backgrounds. Part of the reason for the predominance of white American males in managerial positions may be that they also have been in the field a longer average time than the other groups and have worked in administrative positions for a longer period of time, as well. If this study is ever repeated, it would be important to control for the other variables (i.e., ethnicity, sex, education, etc.) in order to determine which may be the major ones accounting for the differences. Another aspect to examine is the change over the last several years: it appears that the amount of time in research and the level of education may be decreasing in importance as determiners of managerial position.

The fact that a significant number of subjects in high management hold bachelor's and master's degrees shows that a doctorate is not essential to successful management of an R&D project. The statistics, however, seem to indicate that women, ethnic minorities, and those with bachelor's or master's degrees tend to be found mainly in projects categorized as technical assistance or product development rather that high technical research. One might infer that technical assistance R&D can be conducted by talented individuals without the need for the rigor of technical research skills that a heavily research-oriented project would require.

Recommendations

Generalizations made from the conclusions must be limited to statements concerning the personnel and job positions at Far West Laboratory. Although the study included subjects from more than 30 R&D projects, generalizations about job requirements in educational R&D at large cannot be made because subjects from other R&D laboratories and centers are not included.

The procedures and competency profile developed in this study could be adapted for an extensive study which would include subjects from the educational R&D field at large. The survey instrument itself must be refined further to improve the reliability of the competency categories. Some categories would have to be reformulated -- redundant and unreliable items deleted, and new items added.

As it is, the competency profile produced by this study can serve effectively as a guide to designing the content and emphasis of programs whose particular scope of work is in developing educational R&D project managers.

In addition, the profile can be used as a guide to assessing interns' progress in R&D management programs. To be used as a screening instrument, it would have to undergo further refinement. Toward this objective, an examination should be made of how to integrate this study's competency-based profile with the Hay Rating System so as to evaluate management positions, as well as to select and screen interns for training in educational R&D project management.

These findings have particular importance to the emphasis that can be given to the Women and Minorities Leadership Training Program. Results of the study imply that special emphasis should be given to the competencies related to management know-how and the capacity to handle and be accountable for projects with diverse activities and tasks and having medium to large budgets.

The concluding recommendation is that a further study be conducted to include subjects from the educational R&D field at large, in order to determine more conclusively what competencies are essential for the preparation of those who aspire to be leaders in educational R&D. The implications of this particular study at Far West Laboratory are that the management competencies are of utmost importance. If this is true in the field at large, then other programs invested in preparing high-level professionals for advanced R&D careers need to

include management areas in their programs.

It is strongly recommended that a further study be made of the importance given to technical research skills, as this study's findings show that these particular skills are not essential to conducting educational R&D at the managerial level.

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APPENDIX A

DEFINITION OF TERMS

APPENDIX A

DEFINITION OF TERMS

Some of the terms used in this study are interpreted differently by individual professionals in the field of educational R&D. To avoid misinterpretation, the following definitions are provided:

1. Educational R&D. Research and development, referring to various broad categories which describe the work performed in this field to improve education.

2. Project manager or leader. A person responsible for directing an educational R&D project. (At Far West Laboratory, this term is synonymous with Principal Investigator, or PI.) A project manager or leader is distinguished from a person who may have project coordination responsibilities, but who is not designated as responsible for the overall project operation.

3. Principal Investigator (PI). The person who is responsible for directing and managing an R&D project so as to produce what is promised in the proposal. The PI also is responsible for maintaining contact with the funding sources and providing required reports and outcomes. (At Far West Laboratory, this term is synonymous with project manager or leader.)

4. Nonmanagers (program staff). Professional staff members responsible for carrying out project tasks. They are not in the capacity of directing others or the project itself. This classification includes staff members who occasionally may be responsible for overseeing the work of others for a short term (as in a team project), but who are not on the same level as the project manager or PI.

5. Competencies. Skills needed to perform specific tasks in educational R&D.

6. Type of research project. This refers to the major purpose of an R&D project (e.g., a project having the primary purpose of providing on-site training to teachers and staff developers is a technical assistance project.) Four varieties of R&D projects are identified in this project: research, technical assistance, product development, and dissemination.

7. The Hay Rating System. A means to evaluate a job by examining and rating the know-how required, the problem-solving responsibilities entailed, and the accountability expected in the performance of the job. A complete description of these aspects of the jobs evaluated is in a previous section of this report, "Instruments for Gathering Data."

APPENDIX B

HAY RATING SYSTEM

FAR WEST LABORATORY
FOR EDUCATIONAL RESEARCH AND DEVELOPMENT

MARCH 1979

GUIDE HAY CHART

KNOW-HOW

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DEFINITION: Know-How is the sum total of every kind of skill, however acquired, needed for acceptable job performance. Know-How has three dimensions – the requirements for:

- • Practical procedures, specialized techniques, and scientific disciplines.
- •• Know-How of integrating and harmonizing the diversified functions involved in managerial situations occurring in operating, supporting, and administrative fields. This Know-How may be exercised consultatively (about management) as well as executively, and involves in some combination the areas of organizing, planning, executing, controlling, and evaluating.
- ••• Active, practicing, person-to-person skills in the area of human relationships.

MEASURING KNOW KNOW: Know-How has both scope (variety) and depth (thoroughness). Thus, a job may require some knowledge about a lot of things, or a lot of knowledge about a few things. The total Know-How is the combination of scope and depth. This concept makes practical the comparison and weighing of the total Know-How content of different jobs in terms of: "HOW MUCH KNOWLEDGE ABOUT HOW MANY THINGS."

	•• MANAGERIAL KNOW-HOW									
	I. NONE OR MINIMAL Performance or supervision of an activity (or activities) highly specific as to objective and content, with appropriate awareness of related activities.			II. RELATED Operational or conceptual integration or coordination of activities which are relatively homogeneous in nature and objective.			III. DIVERSE Operational or conceptual integration or coordination of activities which are diverse in nature and objectives, in an important management area.			
••• Human Relations Skills →	1	2	3	1	2	3	1	2	3	
PRACTICAL PROCEDURES / SCIENTIFIC DISCIPLINES SPECIALIZED TECHNIQUES **A. PRIMARY** Elementary plus some secondary (or equivalent) education; plus work indoctrination.	50	57	66	66	76	87	87	100	115	1
	57	66	76	76	87	100	100	115	132	A 2
	66	76	87	87	100	115	115	132	152	3
B. ELEMENTARY VOCATIONAL Familiarization in uninvolved, standardized work routines and/or use of simple equipment and machines.	66	76	87	87	100	115	115	132	152	3
	76	87	100	100	115	132	132	152	175	B 4
	87	100	115	115	132	152	152	175	200	5
C. VOCATIONAL Procedural or systematic proficiency, which may involve a facility in the use of specialized equipment.	87	100	115	115	132	152	152	175	200	5
	100	115	132	132	152	175	175	200	230	C 6
	115	132	152	152	175	200	200	230	264	7
D. ADVANCED VOCATIONAL Some specialized (generally nontechnical) skill(s), however acquired, giving additional breadth or depth to a generally single functional element.	115	132	152	152	175	200	200	230	264	7
	132	152	175	175	200	230	230	264	304	D 8
	152	175	200	200	230	264	264	304	350	8
E. BASIC TECHNICAL-SPECIALIZED Sufficiency in a technique which requires a grasp either of involved practices and precedents; or of scientific theory and principles; or both.	152	175	200	200	230	264	264	304	350	9
	175	200	230	230	264	304	304	350	400	10
	200	230	264	264	304	350	350	400	460	11
F. SEASONED TECHNICAL-SPECIALIZED Proficiency, gained through wide exposure or experiences in a specialized or technical field, in a technique which combines a broad grasp either of involved practices and precedents; or of scientific theory and principles; or both.	200	230	264	264	304	350	350	400	460	11
	230	264	304	304	350	400	400	460	530	F 12
	264	304	350	350	400	460	460	530	600	13
G. TECHNICAL-SPECIALIZED MASTERY Determinative mastery of techniques, practices and theories gained through wide seasoning and/or special development.	264	304	350	350	400	460	460	530	600	13
	304	350	400	400	460	530	530	600	700	G 14
	350	400	460	460	530	600	600	700	800	15
H. PROFESSIONAL MASTERY Exceptional and unique mastery in scientific or other learned disciplines.	350	400	460	460	530	600	600	700	800	15
	400	460	530	530	600	700	700	800	930	H 16
	460	530	600	600	700	800	800	930	1060	17

••• HUMAN RELATIONS SKILLS		
1. **BASIC:** Ordinary courtesy and effectiveness in dealing with others.	2. **IMPORTANT:** Understanding, influencing, and/or serving people are important, but not critical considerations.	3. **CRITICAL:** Alternative or combined skills in understanding, selecting, developing and motivating people are important in the highest degree.

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FAR WEST LABORATORY
FOR EDUCATIONAL RESEARCH AND DEVELOPMENT

MARCH 1979

DEFINITION: Accountability is the answerability for an action and for the consequences thereof. It is the measured effect of the job on end results. It has three dimensions in the following order of importance:

- Freedom to Act — the degree of personal or procedural control and guidance as defined in the left hand column below.
- • Job Impact on End Results — as defined at upper right.
- • • • Magnitude — Indicated by the general dollar size of the overall most clearly or primarily affected by the job, (on an annual basis), stated in terms of Constant Dollars, 1985 Base.

GUIDE HAY CHART

ACCOUNTABILITY

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• • IMPACT OF JOB ON END RESULTS

INCIDENTAL: Informational, recording, or incidental services for use by others in relation to some important end result.

CONTRIBUTORY: Interpretive, advisory, or facilitating services for use by others in taking action.

SHARED: Participating with others (except own subordinates and superiors), within or outside the organizational unit, in taking action.

PRIMARY: Controlling impact on end results, where shared accountability of others is subordinate.

• • • MAGNITUDE →
AMI EQUIVALENT →
• • IMPACT →

AMI for use with 1978 dollars is 203.

FREEDOM TO ACT	(1) VERY SMALL OR INDETERMINATE Under $100 M				(2) SMALL $100 M - $1 MM				(3) MEDIUM $1 MM - $10 MM				
	REMOTE	CONTRIB.	SHARED	PRIMARY	REMOTE	CONTRIB.	SHARED	PRIMARY	REMOTE	CONTRIB.	SHARED	PRIMARY	
A. PRESCRIBED These jobs are subject to: Direct and detailed instructions Close supervision	10	14	19	26	14	19	26	33	19	26	33	43	
	12	16	22	29	16	22	29	38	22	29	38	50	A
	14	19	26	33	19	26	33	43	26	33	43	57	
B. CONTROLLED These jobs are subject to: Instructions and established work routines Close supervision	16	22	29	38	22	29	38	50	29	38	50	66	
	19	26	33	43	26	33	43	57	33	43	57	76	B
	22	29	38	50	29	38	50	66	38	50	66	87	
C. STANDARDIZED These jobs are subject, wholly or in part, to: Standardized practices and procedures General work instructions Supervision of progress and results	26	33	43	57	33	43	57	76	43	57	76	100	
	29	38	50	66	38	50	66	87	50	66	87	115	C
	33	43	57	76	43	57	76	100	57	76	100	132	
D. GENERALLY REGULATED These jobs are subject, wholly or in part, to: Practices and procedures covered by precedents or well-defined policy Supervisory review	38	50	66	87	50	66	87	115	66	87	115	152	
	43	57	76	100	57	76	100	132	76	100	132	175	D
	50	66	87	115	66	87	115	152	87	115	152	200	
E. DIRECTED These jobs, by their nature or size, are subject to: Broad practice and procedures covered by functional precedents and policies Achievement of a circumscribed operational activity Managerial direction	57	76	100	132	76	100	132	175	100	132	175	230	
	66	87	115	152	87	115	152	200	115	152	200	264	E
	76	100	132	175	100	132	175	230	132	175	230	304	
F. ORIENTED DIRECTION These jobs, by their nature or size, are broadly subject to: Functional policies and goals General managerial direction	87	115	152	200	115	152	200	264	152	200	264	350	
	100	132	175	230	132	175	230	304	175	230	304	400	F
	115	152	200	264	152	200	264	350	200	264	350	460	
G. BROAD GUIDANCE These jobs are inherently subject only to broad policy and general management guidance	132	175	230	304	175	230	304	400	230	304	400	528	
	152	200	264	350	200	264	350	460	264	350	460	608	G
	175	230	304	400	230	304	400	528	304	400	528	700	
H. GENERALLY UNGUIDED	200	264	350	460	264	350	460	608	350	460	608	800	
	230	304	400	528	304	400	528	700	400	528	700	920	H
	264	350	460	608	350	460	608	800	460	608	800	1056	

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MARCH 1970

GUIDE HAY CHART

PROBLEM-SOLVING

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DEFINITION: Problem Solving is the original "self-starting" thinking required by the job for analyzing, evaluating, creating, reasoning, arriving at and making conclusions. To the extent that thinking is circumscribed by standards, covered by precedents, or referred to others, Problem Solving is diminished and the emphasis correspondingly is on Know-How.

Problem Solving has two dimensions:

- The environment in which the thinking is to take place.
- The challenge presented by the thinking to be done.

MEASURING PROBLEM SOLVING: Problem Solving measures the intensity of the mental process which employs Know-How to: (1) identify, (2) define, and (3) resolve a problem. "You think with what you know." This is true of even the most creative work... The raw material of any thinking is knowledge of facts, principles, and means; ideas are put together from something already there. Therefore, Problem Solving is treated as a percentage utilization of Know-How.

STEP VALUES	
	2112
	1848
—	1600 —
	1400
	1211
	1056
	920
—	800 —
	700
	608
	528
	460
—	400 —
	350
	304
	264
	230
—	200 —
	175
	152
	132
	115
	100 —
1 —	87
2 —	76
—	66
4 —	57
5 —	50 —
6 —	43
7 —	38
8 —	33
9 —	29
10 —	25 —
11 —	22
12 —	19
13 —	16
14 —	14
15 —	12 —
16 —	10
17 —	9
18 —	8
19 —	7
20 —	6 —

← STEPS BELOW 100%

Thinking guided or circumscribed by: (THE ENVIRONMENT — GENERALIZED → THE THINKER — SPECIFIC)	THINKING CHALLENGE: 1. REPETITIVE — Identical situations requiring solution by simple choice of learned things.	2. PATTERNED — Similar situations requiring solution by discriminating choice of learned things.	3. INTERPOLATIVE — Differing situations requiring search for solutions within area of learned things.	4. ADAPTIVE — Variable situations requiring analytical, interpretive, evaluative, and/or constructive thinking.	5. UNCHARTED — Novel or nonrecurring pathfinding situations requiring the development of new concepts and imaginative approaches.	
A. STRICT ROUTINE — Simple rules and detailed instructions.	10% / 12%	14% / 16%	19% / 22%	26% / 29%	33% / 38%	A
B. ROUTINE — Established routines and standing instructions.	12% / 14%	16% / 19%	22% / 26%	29% / 33%	38% / 43%	B
C. SEMI-ROUTINE — Somewhat diversified procedures and precedents.	14% / 16%	19% / 22%	26% / 29%	33% / 38%	43% / 50%	C
D. STANDARDIZED — Substantially diversified procedures and specialized standards.	16% / 19%	22% / 26%	29% / 33%	38% / 43%	50% / 57%	D
E. CLEARLY DEFINED — Clearly defined policies and principles.	19% / 22%	26% / 29%	33% / 38%	43% / 50%	57% / 66%	E
F. BROADLY DEFINED — Broad policies and specific objectives.	22% / 26%	29% / 33%	38% / 43%	50% / 57%	66% / 76%	F
G. GENERALLY DEFINED — General policies and ultimate goals.	26% / 29%	33% / 38%	43% / 50%	57% / 66%	76% / 87%	G
H. ABSTRACTLY DEFINED — General laws of nature or science, business philosophy and cultural standards.	29% / 33%	38% / 43%	50% / 57%	66% / 76%	87% / 100%	H

These Guide Charts are for use in the United States by the client named above and may not be reproduced without the permission of Hay Associates.

APPENDIX C

SURVEY INSTRUMENT

FAR WEST LABORATORY FOR EDUCATIONAL RESEARCH AND DEVELOPMENT

INTEROFFICE MEMORANDUM

Date 24 January 1980

To:

From: Nat DeAnda

Subject: Survey of Competencies Essential for Educational R&D Project Management

We received in-house funding to conduct an independent study of competencies essential to R&D project management. The attached questionnaire is an attempt to identify these competencies.

We're asking that you respond to this questionnaire by thinking of the requirements of your present job as project director or manager.

Note that there are three categories of responses to rate:

(A) The degree to which you need to master the competency to function in your job.

(B) The frequency with which the competency is used in carrying out your job.

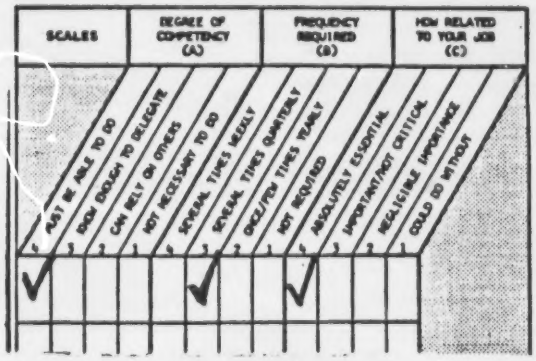
(C) The extent to which the competency is related to your job.

An example is provided here to insure that you understand how to respond to each item:

EXAMPLE:

The ability to:

- Define responsibilities of staff members



The information from these three categories will help us to determine the extent to which each competency is essential to R&D management. We plan to use this information as part of our training program for the interns in the Women & Minorities program.

Please code your time to: 0199-01-01.

WE WOULD LIKE TO HAVE THESE QUESTIONNAIRES RETURNED TO US BY FRIDAY, FEBRUARY 1.

Thank you.

FAR WEST LABORATORY
FOR EDUCATIONAL RESEARCH AND DEVELOPMENT

SURVEY QUESTIONNAIRE:

COMPETENCIES ESSENTIAL TO R&D PROJECT MANAGEMENT

Conducted by: Nat DeAnda, Ph.D.
Director, Women & Minorities Leadership Program

SURVEY QUESTIONNAIRE:

COMPETENCIES ESSENTIAL TO R&D PROJECT MANAGEMENT

(Please circle the appropriate letter.)

1. *NAME:* _____

   POSITION: (A) *Principal Investigator* (B) *Other (please specify)* _____

2. *SEX:* (A) *Female* (B) *Male*

3. *ETHNIC BACKGROUND:*

   (A) *White* (E) *Native American*
   (B) *Black American* (F) *Filipino*
   (C) *Hispanic* (G) *Other (please specify)* _____
   (D) *Oriental*

4. *YEARS IN EDUCATIONAL RESEARCH:*

   (A) *0-3 yrs.* (C) *6-10 yrs.*
   (B) *3-6 yrs.* (D) *10 or more yrs.*

5. *EXPERIENCE IN R&D PROJECT ADMINISTRATION:*

   (A) *0-1 yr.* (D) *4-6 yrs.*
   (B) *1-2 yrs.* (E) *6-10 yrs.*
   (C) *2-4 yrs.* (F) *10 or more yrs.*

6. *EDUCATION:* (A) *B.A. or B.S.* (B) *M.A. or M.S.* (C) *Ph.D. or Ed.D.*
   (D) *Post-Ph.D. Fellowships (or other studies)*

7. *PROJECT TITLE:* _____

   TYPE OF PROJECT:
   (A) *Dissemination* (D) *Product Development*
   (B) *Technical Assistance* (E) *Publications*
   (C) *Research* (F) *Other (please specify)* _____

SURVEY: COMPETENCIES ESSENTIAL TO R&D PROJECT MANAGEMENT (1/23/80)

There are 166 survey items on the following 11 pages.

Each item will have (3) responses: one each in Categories A, B, and C.

Please check (✓) accordingly.

	SCALES	DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
The ability to:		5 MUST BE ABLE TO DO	3 EASY ENOUGH TO DELEGATE	2 CAN RELY ON OTHERS	1 NOT NECESSARY TO DO	5 SEVERAL TIMES WEEKLY	3 SEVERAL TIMES QUARTERLY	2 ONCE/FEW TIMES YEARLY	1 NOT REQUIRED	5 ABSOLUTELY ESSENTIAL	3 IMPORTANT/NOT CRITICAL	2 NEGLIGIBLE IMPORTANCE	1 COULD DO WITHOUT
1.	Assess employee performance, work schedule, and expenditure rate of project contract												
2.	Set priorities for project tasks												
3.	Determine amount of time for completing project tasks with consideration to staff capabilities												
4.	Make necessary tradeoffs between scheduled deadlines, budget allocations, and personnel performance to accomplish project goals												
5.	Participate as a contributing team member on laboratory committees												
6.	Establish means to acknowledge staff members' accomplishments as part of the reward system in your project												
7.	Confront and/or dismiss malperforming personnel												
8.	Structure meetings relevant to staff concerns and project needs												
9.	Train and develop personnel to perform project tasks												
10.	Plan, coordinate, and control activities of project personnel												
11.	Establish lines of authority for staff supervision												
12.	Assign personnel to specific project tasks according to the strengths of each person												
13.	Define responsibilities of staff												
14.	Create a safe climate and procedure for eliciting staff input regarding project progress												
15.	Define and structure responsibilities of project consultants												
16.	Write job descriptions for full-time, part-time, or consultant personnel												

Each item has (3) responses: one each in Categories A, B, and C

The ability to:	SCALES	DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
		5 MUST BE ABLE TO DO	3 HAVE ENOUGH TO DELEGATE	2 CAN HELP OR OTHERS	1 NOT NECESSARY TO DO	5 SEVERAL TIMES DAILY	3 SEVERAL TIMES WEEKLY	2 ONCE/FEW TIMES QUARTERLY	1 NOT REQUIRED	5 ABSOLUTELY ESSENTIAL	3 IMPORTANT/NOT CRITICAL	2 NEGLIGIBLE IMPORTANCE	1 COULD DO WITHOUT
33.	Interpret & communicate organizational policy to subordinates												
34.	Select staff with actual or potential skills for performing project tasks												
35.	Organize team efforts based on professional abilities & personalities of staff members												
36.	Provide close supervision during initial stages of project implementation												
37.	Establish framework for resolving problems & conflicts affecting task performance												
38.	Implement a system for collecting information about work activity through reports, observations, staff meetings, & product reviews												
39.	Use face-to-face communication to accomplish management tasks												
40.	Reply appropriately to all correspondence related to the project												
41.	Use personal contact for maintaining professional relationships												
42.	Contact & communicate with public and private agency personnel												
43.	Evaluate or critique written/oral presentations												
44.	Engage in effective oral communication with project staff												
45.	Facilitate group work sessions by eliciting staff input & managing discussions												
46.	Assist staff to identify & clarify project objectives and tasks												
47.	Obtain & use feedback from different sources (staff members, supervisors, and/or peers) to assess project progress												
48.	Motivate others to accomplish project objectives												

Each item has (3) responses: one each in Categories A, B, and C.

The ability to:	SCALES	DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
		5 MUST BE ABLE TO DO	3 DOW ENOUGH TO DELEGATE	2 CAN RELY ON OTHERS	1 NOT NECESSARY TO DO	5 SEVERAL TIMES WEEKLY	3 SEVERAL TIMES MONTHLY	2 ONCE/FEW TIMES YEARLY	1 NOT REQUIRED	5 ABSOLUTELY ESSENTIAL	3 IMPORTANT/NOT CRITICAL	2 NEGLIGIBLE IMPORTANCE	1 COULD DO WITHOUT
17.	Establish project administrative policies, procedures, & guidelines for staff operation												
18.	Use project flow charts to communicate objectives & tasks to staff members												
19.	Use project flow charts to monitor project progress												
20.	Assign jobs to subordinates with clear identification of objectives, tasks, & responsibilities												
21.	Determine salary increases based on assessment of job performance												
22.	Monitor subordinates' activities by using regular reporting & review procedures												
23.	Determine need for reassigning staff to meet project deadlines												
24.	Enforce rules & regulations essential for project operation												
25.	Assess employee attitudes toward their work												
26.	Assess employee attitudes toward their co-workers												
27.	Plan & implement staff development activities												
28.	Perform the jobs of most subordinates												
29.	Establish procedures for communicating information to staff												
30.	Review & evaluate employee effectiveness												
31.	Provide constructive feedback & take corrective action when necessary												
32.	Resolve employee work relationship problems fairly												

Each item has (3) responses: one each in Categories A, B, and C.

The ability to:	SCALES	DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
		MUST BE ABLE TO DO	KNOW ENOUGH TO DELEGATE	CAN DELEGATE TO OTHERS	NOT NECESSARY TO DO	SEVERAL TIMES DAILY	SEVERAL TIMES WEEKLY	SEVERAL TIMES QUARTERLY	NOT REQUIRED	ABSOLUTELY ESSENTIAL	IMPORTANT/NOT CRITICAL	REASONABLE IMPORTANCE	COULD DO WITHOUT
49.	Revise & rewrite articles, project reports, parts of proposals, & other project documents												
50.	Respond extemporaneously to oral questions during meetings or presentations												
51.	Interpret technical content or research data to professionals, parents, & students												
52.	Articulate staff problems to a supervisor or staff members for discussion & solution												
53.	Provide a written description or explanation of project goals, activities, & products												
54.	State objectives of project in measurable terms												
55.	Articulate project goals to administration & staff												
56.	Write on technical subjects in style appropriate to audience addressed												
57.	Assist staff to identify their roles in the project operation & how their activities contribute to the accomplishment of project objectives												
58.	Communicate results of research or evaluation studies to staff or administration												
59.	Disseminate research findings through: presentations, journal publications, research networks, newsletters, & other professional communications												
60.	Prepare project proposals for funding												
61.	Negotiate the final project contract with the funding source												
62.	Identify & resolve scheduling constraints and conflicts												
63.	Estimate personnel requirements necessary to implement the project												
64.	Determine physical facilities necessary for staff & project operation												

Each item has (3) responses: one each in Categories A, B, and C.

The ability to:

		SCALES				DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
		4 MUST BE ABLE TO DO	3 KNOW ENOUGH TO DELEGATE	2 CAN RELY ON OTHERS	1 NOT NECESSARY TO DO	4 SEVERAL TIMES WEEKLY	3 SEVERAL TIMES QUARTERLY	2 ONCE/FEW TIMES YEARLY	1 NOT REQUIRED	4 ABSOLUTELY ESSENTIAL	3 IMPORTANT/NOT CRITICAL	2 NEGLIGIBLE IMPORTANCE	1 COULD DO WITHOUT	
65.	Write proposals within defined specifications, i.e., RFP's													
66.	Establish procedures for implementing decisions													
67.	Identify & assign tasks for initiating the project													
68.	Design & implement a system for interstaff communication													
69.	Plan & implement a system for project documentation													
70.	Estimate resources necessary to accomplish project tasks													
71.	Estimate time required for completion of each task													
72.	Determine schedule for using resources for the duration of the project													
73.	Determine lead time required to acquire each type of resource or skill necessary to accomplish project's objectives													
74.	Make up & use project task-event calendar or flow chart to incorporate: project start date, task milestones, and completion date													
75.	Use a management control technique (i.e., PERT charts, DELTA chart, etc.) to plan & schedule tasks and activities													
76.	Outline steps needed to reach project objectives													
77.	Evaluate present trends & anticipate future needs in RDD&													
78.	Develop new business by writing proposals or expanding the project													
79.	Seek new markets for lab programs & products													
80.	Interpret implications of new legislation for planning the future of the project													

Each item has (3) responses: one each in Categories A, B, and C.

The ability to:	SCALES	DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
		4 MUST BE ABLE TO DO	3 GOOD ENOUGH TO DELEGATE	2 CAN RELY ON OTHERS	1 NOT NECESSARY TO DO	4 SEVERAL TIMES DAILY	3 SEVERAL TIMES WEEKLY	2 ONCE/FEW TIMES YEARLY	1 NOT REQUIRED	4 ABSOLUTELY ESSENTIAL	3 IMPORTANT/NOT CRITICAL	2 NEGLIGIBLE IMPORTANCE	1 COULD DO WITHOUT
81. Assign a hierarchical order to project tasks													
82. Use evaluative information regarding users of products and/or services to determine present & future course of project (needs-sensing committees, surveys, etc.)													
83. Conduct special studies to identify competencies or educational needs of particular groups													
84. Adhere to terms of project contract while assuring quality services or production													
85. Keep up-to-date information on funding by reading relevant sources of information, maintaining contact with private & federal agencies, and reviewing current RFP's & grants competitions													
86. Investigate current methodologies & instructional theories to adapt to specific project needs													
87. Evaluate new information or materials (new products, programs, or research evidence)													
88. Recognize significant deviations from the project plan													
89. Estimate resources and time necessary to prepare proposals for funding													
90. Specify conditions for measuring performance & acceptability standards for each project task													
91. Appraise results of project operations, analyze performance reports, & interpret data													
92. Apply measurement theory & technique to design or supervise instrument development													
93. Formulate a plan to evaluate the project													
94. Use evaluation information to make decisions affecting present project goals & strategies													
95. Identify factors which contribute to the accomplishment of project objectives & outcomes													
96. Develop a proposal for new product development or technical assistance													

Each item has (3) responses: one each in Categories A, B, and C.

The ability to:	SCALES	DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
		5 MUST BE ABLE TO DO	3 KNOW ENOUGH TO DELEGATE	2 CAN RELY ON OTHERS	1 NOT NECESSARY TO DO	5 SEVERAL TIMES WEEKLY	3 SEVERAL TIMES QUARTERLY	2 ONCE/FEW TIMES YEARLY	1 NOT REQUIRED	5 ABSOLUTELY ESSENTIAL	3 IMPORTANT/NOT CRITICAL	2 NEGLIGIBLE IMPORTANCE	1 COULD DO WITHOUT
97.	Evaluate products and/or services and make recommendations for their improvement												
98.	Monitor product development by providing feedback & reviewing prototypes/drafts of materials												
99.	Redesign a product or service to reduce costs while still maintaining its functional value												
100.	Assess latest technical developments for improvement of project services and/or products												
101.	Apply current relevant teaching theory (or theories) to the design of instructional programs and materials												
102.	Design programs to field-test new products, materials, or services												
103.	Devise procedures & steps to develop educational products												
104.	Specify & provide information needed to develop audio-visual or multi-media materials												
105.	Plan development of new products within printing specifications & other limitations												
106.	Assist in contributing to or preparing realistic federal guidelines for new projects												
107.	Prepare & deliver presentations at professional conferences												
108.	Represent the project or the laboratory to outside parent organization or institution												
109.	Develop an alliance with leading researchers & consultants to promote project visibility												
110.	Demonstrate educational products or practices to professionals in R&D or to educational administration												
111.	Work with public school, university, state, or federal agency personnel in collaborative effort to achieve project objectives												
112.	Determine budget to distribute resources for project duration by calculating all elements of cost (staff, consultants, supplies, overhead, etc.)												

Each item has (3) responses: one each in Categories A, B, and C

The ability to:	SCALES	DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
		5 MUST BE ABLE TO DO	3 OKAY ENOUGH TO DELEGATE	2 CAN RELY ON OTHERS	1 NOT NECESSARY TO DO	5 SEVERAL TIMES DAILY	3 SEVERAL TIMES WEEKLY	2 ONCE/FEW TIMES YEARLY	1 NOT REQUIRED	5 ABSOLUTELY ESSENTIAL	3 IMPORTANT/NOT CRITICAL	1 NEGLIGIBLE IMPORTANCE	COULD DO WITHOUT
113. Allocate appropriate amount of funds to various phases of work within the project													
114. Operate within constraints on expenditure schedules & rates imposed by federal, state, and/or local regulations													
115. Give guidance in budget preparation to appropriate project staff													
116. Use budget review procedure (e.g., monthly print-outs) to monitor project expenditures													
117. Justify budget expenses in project operation													
118. Explain discrepancies between planned budget & actual expenditures													
119. Prepare annual budget of at least $100,000													
120. Accurately estimate long-range solvency of the program													
121. Administer line-item budget to ensure proper fund expenditure within project budget													
122. Use cost-accounting procedures to relate project operation to budget specifications													
123. Calculate actual operating project budget to include all fixed & flexible cost elements													
124. Compute costs of producing products and/or rendering services													
125. Adjust scope of work with funding sources as necessary													
126. Report regularly to higher level on project progress													
127. Prepare written technical progress reports													
128. Design system for recording project operations required by funding source													

Each item has (3) responses: one each in Categories A, B, and C.

The ability to:	SCALES: DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
	4 MUST BE ABLE TO DO	3 ENOUGH ENOUGH TO DELEGATE	2 CAN RELY ON OTHERS	1 NOT NECESSARY TO DO	4 SEVERAL TIMES WEEKLY	3 SEVERAL TIMES QUARTERLY	2 ONCE/FEW TIMES YEARLY	1 NOT REQUIRED	4 ABSOLUTELY ESSENTIAL	3 IMPORTANT/NOT CRITICAL	2 NEGLIGIBLE IMPORTANCE	1 COULD DO WITHOUT
129. Prepare evaluative report at project completion												
130. Prepare final reports required for the project												
131. Synthesize or summarize project progress												
132. Edit own & others' writing to include in project records and/or reports												
133. Write clear technical reports on planning, research, or evaluation of the project												
134. Interpret data to extract all relevant information												
135. Apply descriptive statistical techniques												
136. Apply multivariate analysis (Anova or Ancova designs) techniques												
137. Apply correlation techniques												
138. Apply statistical regression techniques												
139. Apply T-tests and critical ratios												
140. Apply factor analytic techniques												
141. Recognize theoretical assumptions underlying various statistical techniques												
142. Interpret & integrate statistical data for presentation to staff & other professionals												
143. Determine which computer program is needed to analyze research data												
144. Design card layouts to allow data analysis within computer constraints & ability to use standardized computer programs (e.g., BMD series)												

Each item has (3) responses: one each in Categories A, B, and C.

The ability to:

		SCALES	DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
			5 MUST BE ABLE TO DO	3 KNOW ENOUGH TO DELEGATE	2 CAN RELY ON OTHERS	1 NOT NECESSARY TO DO	5 SEVERAL TIMES WEEKLY	3 SEVERAL TIMES MONTHLY	2 ONCE/FEW TIMES YEARLY	1 NOT REQUIRED	5 ABSOLUTELY ESSENTIAL	3 IMPORTANT/NOT CRITICAL	2 NEGLIGIBLE IMPORTANCE	1 COULD DO WITHOUT
145.	Write computer programs													
146.	Analyze data according to limitations of computer system used													
147.	Code computer programs													
148.	Interpret computer print-out for self & staff													
149.	Apply alternate methods of presenting statistical data (i.e., charts, graphs, or tables)													
150.	Design or conduct interviews for data collecting purposes													
151.	Apply measurement theory in instrument construction													
152.	Select appropriate standardized tests or instruments, depending on purpose													
153.	Apply general principles of research design, i.e., sampling theory, control of dependent variables, hypothesis formulation													
154.	Apply specific experimental and quasi-experimental research designs													
155.	Recognize factors which jeopardize internal and external validity													
156.	Design studies to control extraneous variables													
157.	Identify variables which should be controlled in a research or evaluation study													
158.	Formulate testable hypothesis or answerable questions in a research or evaluation study													
159.	Choose (or design) appropriate statistical techniques for data analysis													
160.	Apply knowledge of statistics in the choice of an evaluation design													

Each item has (3) responses, one each in Categories A, B, and C.

The ability to:

		SCALES	DEGREE OF COMPETENCY (A)				FREQUENCY REQUIRED (B)				HOW RELATED TO YOUR JOB (C)			
			4 MUST BE ABLE TO DO	3 KNOW ENOUGH TO DELEGATE	2 CAN RELY ON OTHERS	1 NOT NECESSARY TO DO	4 SEVERAL TIMES WEEKLY	3 SEVERAL TIMES QUARTERLY	2 ONCE/FEW TIMES YEARLY	1 NOT REQUIRED	4 ABSOLUTELY ESSENTIAL	3 IMPORTANT/NOT CRITICAL	2 NEGLIGIBLE IMPORTANCE	1 COULD DO WITHOUT
161.	Test instrument reliability, including types of reliability coefficients													
162.	Apply established procedures to determine instrument validity													
163.	Act as consultant and advisory board member to other related projects													
164.	Determine how project findings can be made available to educational practitioners													
165.	Develop collaborative and interactive relationships with other related projects													
166.	Inform educational community about services & products of project													

"END OF DOCUMENT"